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ABSTRACT

The aims of this course of study are to provide a solid conceptual base in mathematics for grades K-12 as well as to assure mastery of computational skills. Features include an emphasis on inquiry and discovery techniques, the presentation of the metric system and the English system separately, and an attempt to meet problem-solving needs in real-life experiences. The major emphasis of each course is pointed out, general objectives are given, and a program outline presented. (MP)

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ALABAMA COURSE OF STUDY

MATHEMATICS

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ALABAMA COURSE OF STUDY

MATHEMATICS

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State Superintendent of Education
Alabama State Department of Education
Montgomery, Alabama 36130

February 1978

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The direct involvement of teachers in development of subject area curricula is a practice of long standing in the Alabama State Department of Education. The document which follows was developed by a representative group of elementary and secondary mathematics' teachers, college professors, supervisors of instruction, and State Department of Education personnel.

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INTRODUCTION

During the last decade the emphasis in mathematics has been on the structure or the "why" of mathematics while computational skills have been de-emphasized. The aims of this course of study are not only to provide a solid conceptual base but also to assure mastery of computational skills.

The grade level content suggested in this course of study is recommended but cannot realistically be considered as representing ideal content for all learners. The basic concepts introduced in kindergarten and the first grade are expanded and extended at each succeeding level. These topics, together with the associated skills, form an essential part of the mathematical background that all students will need as adults and at the same time will establish a solid foundation for future study of mathematics.

Helping students to develop mathematical concepts through inquiry and discovery techniques is basic to this program. This type of learning encourages students to be more perceptive, inventive, and self-reliant. Concepts which students learn for themselves will mean more to them than those which they accept passively and learn mechanically.

Since students' understanding and skill will improve with repeated experiences, computational practice is a necessary part of a sound mathematics program. Continued assessment of student development and needs provides opportunities for maximum learning and students should be challenged to reach their maximum potential.

Mathematics should be taught in a way that is both pleasing and satisfying to the learner. The satisfaction and confidence gained from

experiencing success is necessary to learning. Since mathematical ideas are abstracted by the student through active encounters with his environment, it is important that activities be provided which will demonstrate the relevance and importance of mathematics in everyday life.

In the near future the United States will be using the International System of Units (SI) as its standard system of measurement. It is our responsibility as educators to provide the stepping stones for this change. This system should be incorporated into the school program from kindergarten through grade twelve and should be taught as a discrete body of knowledge. The customary (English) system will continue in use for a long time and must also be taught as a separate system. Do not teach conversion from one system to the other.

Students today are growing up in a technological age where mathematics plays an increasingly important role. More mathematics has been created during the 20th Century than in all of the rest of history. Space travel, as we know it today, would have been impossible without computers and calculators. The advent of the high speed computing machine has made possible mathematical applications heretofore thought to be impossible. The availability of small calculators makes it necessary to place emphasis upon approximation to determine the reasonableness of an answer.

This course of study is also designed to meet problem-solving needs in real-life experiences which range from the tasks of the homemaker to those of the highly trained technician. Problem-solving needs arise in one's vocation and also in leisure activities. Students should become increasingly aware of the relevance of mathematics in these situations and develop positive attitudes toward the study of mathematics.

The course of study for mathematics for the State of Alabama is a diverse curriculum responsive to the needs, interests, and abilities of all students. It is characterized by flexibility and designed to meet the needs of a constantly changing society. Recognizing that there are individual differences in students, teachers, and schools, this mathematics program is designed to be used as a general curriculum guide.

MATHEMATICS - KINDERGARTEN

The background which kindergarten children bring to school and the interest of young children in activities involving mathematics should give some direction to an integral part of the kindergarten program. Early experiences involving mathematics may serve as an essential foundation in the development of later mathematical content. Many of these early experiences will be generated through the involvement of children with physical objects that are usually found in the environment. Experiences or activities may also be centered on materials designed to develop certain mathematical ideas.

Kindergarten children should be encouraged to compare, classify, and arrange objects according to shape, color, and size; to experiment with symmetry and balance; and to discover and create patterns. They should discover the comparative relations of "more," "fewer," and "as many as" through the activity of matching groups of objects. In these activities children develop understanding of mathematical concepts. while learning to name and understand the number of a set, to count, and to develop positional relationships such as inside, outside, on, first, next, last, before, after, between, left, right, above, and below. The objectives and program outline for the kindergarten mathematics program will reflect the above overview of mathematics for the kindergarten child.

General Objectives

1. The student develops an appreciation for and a positive attitude toward mathematics through an awareness of mathematics in his real-life situations.
2. The student acquires knowledge and understanding of numbers and

mathematical operations appropriate to his mental maturity level.

3. The student develops skills in comparing and arranging objects with respect to their physical characteristics.
4. The student demonstrates a knowledge of positional relationships.
5. The student explores his environment at school and home to acquire and relate information of a mathematical nature.
6. The student develops skill in using appropriate language applicable to quantitative situations in his real-life activities--home life, play, school work, conversation, and socialization.

KINDERGARTEN
PROGRAM OUTLINE

I. Numbers - Numeration

A. Symbol Perception

1. Numerals - 0-10
2. Vocabulary of number names - 0-10
3. Counting of the members of a set - 1-10
4. Ordinal number to 5th
5. One-half as related to regions, sets, and other subjects
6. Matching of numerals to members of a set
7. Ordering
 - a. Fewest to most
 - b. Between, after, before
8. Number Patterns

B. Whole number operations

1. Joining of sets to 6
2. Separating of sets to 5

II. Measurement

A. Time

1. Day and night
2. Breakfast, lunch, dinner (supper)
3. Early and late
4. Days of the week
5. Months
6. Seasons

B. Money

1. Cent, nickel, dime, quarter
2. Value of coins

C. Quantity

1. Same
2. All
3. More and less
4. Many and few

D. Linear (informal usage rather than memorization or comparison of one system to another)

1. Centimeter, decimeter
2. Inch, foot

E. Capacity (informal usage rather than memorization or comparison of one system to another)

1. Liter
2. Quart
3. Cup

F. Mass (informal usage rather than memorization or comparison of one system to another)

1. Gram, kilogram
2. Pound

IV. Geometry

A. Positional terms

1. Inside, outside, on
2. Before, after, between, beside

B. Shapes

1. Square
2. Rectangle
3. Triangle
4. Circle

MATHEMATICS - GRADE ONE

The first grade mathematics program should develop a variety of carefully sequenced experiences and activities. These should motivate young children and help them to develop a positive attitude toward the study of mathematics. It is hoped that through this program an appreciation of the importance of our numeration, money, and measurement systems will be developed.

General Objectives

1. The student develops a working knowledge of the numeration system as it relates to the operation and properties of addition and subtraction, using numbers 0-200.
2. The student uses the appropriate English and metric (SI) units of measure.
3. The student recognizes and identifies geometric shapes, their related properties and relationships.
4. The student recognizes and demonstrates fractional parts of regions and sets including halves, thirds, and fourths.

GRADE ONE
PROGRAM OUTLINE

I. Numbers - Numeration

- A. Base ten system
 - 1. Reading and writing of numerals 0-200
 - 2. Counting of cardinal numbers by 1's, 2's, 5's, and 10's, to 100
 - 3. Cardinal numbers in a set
 - 4. Ordinal numbers through twelfth
 - 5. Different numerals to express the same number
 - 6. Place value to hundreds place
 - 7. One-to-one correspondence
- B. Symbol perception +, -, =, <, >, ()

II. Whole Numbers

- A. Operations
 - 1. Addition and subtraction facts with sums and minuends to 18
 - 2. Vertical and horizontal forms for addition and subtraction
 - 3. Addition and subtraction with two-place numerals without regrouping.
 - 4. Addition of three-place numerals without regrouping
 - 5. Commutative and associative properties of addition
 - 6. Subtraction as the inverse of addition
- B. Application
 - 1. Interpretation of number stories
 - 2. Formulation of creative story problems

III. Fractional Numbers

- A. One-half, one-third, one-fourth of an object
- B. One-half, one-third, one-fourth of members in a set

IV. Measurement

- A. Metric system (SI)
 - 1. Linear - centimeter, decimeter, meter
 - 2. Capacity
 - a. Liter
 - b. Cup
 - 3. Mass - gram, kilogram
 - 4. Temperature - Celsius thermometer
- B. English system
 - 1. Linear - inch, foot, yard
 - 2. Liquid
 - a. Half-pint, pint, quart
 - b. Cup

3. Mass - ounce, pound
4. Time - half-hour, hour
5. Money
 - a. Cent, nickel, dime
 - b. Quarter, half-dollar, dollar
6. Temperature - Fahrenheit thermometer
7. Calendar
 - a. Days
 - b. Weeks
 - c. Months
- C. Estimation
 1. Nearest centimeter, decimeter, meter
 2. Nearest inch, foot, yard

V. Functions and Graphs

- A. Pictographs
- B. Single bar graphs

VI. Geometry

- A. Geometric shapes
 1. Circle
 2. Square
 3. Triangle
 4. Rectangle
- B. Lines and line segments
 1. Curves
 2. Closed
 3. Not closed

VII. Number Theory

- A. Number patterns
- B. Odd and even numbers

MATHEMATICS - GRADE TWO

The emphasis of the second grade mathematics program is on the development and maintenance of computational skills. A simple and straightforward approach should be used in the development of the basic operations and emphasis should be placed on the working forms that the student will actually use.

In presenting the basic operations this program suggests meaningful use of the properties of numbers and of our system of numeration. The second grade program should include an emphasis on the practical application of mathematics in life situations. There should be a manipulative approach, moving to the abstract only after much experience in "doing."

General Objectives

1. The student commits to memory addition and subtraction facts.
2. The student demonstrates development of symbol perception and vocabulary related to basic operations, fractions, measurement, and geometric concepts.
3. The student develops a working knowledge of the numeration system as it relates to the operation and properties of addition and subtraction using numbers 0-1000.
4. The student demonstrates recognition of the usefulness of mathematics by relating its use to simple life situations.
5. The student demonstrates an understanding of the base ten system by reading, writing, and counting numbers to 999, using ordinal numbers through twelfth, and showing place value to hundreds place.

6. The student uses the number line and open number sentences in mathematical operations.
7. The student demonstrates his understanding of the multiplication operation in two ways: (1) as successive addition and (2) through the use of the commutative property.
8. The student solves problems by the interpretation of number stories and the formulation of creative story problems.
9. The student gains knowledge of simple fractional numbers by finding fractional parts of an object and a set.
10. The student increases his knowledge of measurement.
11. The student reads simple graphs.
12. The student becomes acquainted with simple geometric shapes.

GRADE TWO
PROGRAM OUTLINE

I. Numbers - Numeration

- A. Symbol perception +, -, x, =, <, >, ()
- B. Base ten system
 - 1. Reading and writing of numerals 0-999
 - 2. Counting of cardinal numbers by 2's, 5's, 10's, and 100's to 1000
 - 3. Cardinal numbers in a set
 - 4. Ordinal numbers through twentieth
 - 5. One-to-one correspondence
 - 6. Different numerals to express the same number
 - 7. Place value to hundreds place

II. Whole Numbers

- A. Operations
 - 1. Addition and subtraction facts with sums and minuends to 18
 - 2. Vertical and horizontal
 - 3. Addition and subtraction with two-place and three-place numerals without regrouping
 - 4. Addition and subtraction of two-place numerals with regrouping
 - 5. Addition of three-place numerals with regrouping
 - 6. Commutative and associative properties of addition
 - 7. Subtraction as the inverse of addition
 - 8. Recognize that subtraction is not commutative
 - 9. Number line in mathematical operations
 - 10. Number sentences, including variable in different positions
 - 11. Multiplication as successive addition
 - 12. Commutative property of multiplication
- B. Application through problem solving
 - 1. Interpretation of number stories
 - 2. Formulation of creative story problems

III. Fractional Numbers

- A. Common fractions
 - 1. One-half, one-fourth, three-fourths, one-third, two-thirds of an object
 - 2. One-half, one-fourth, three-fourths, one-third, two-thirds of the members in a set
- B. Decimal fractions - decimal point with monetary expressions

IV. Measurement

- A. Metric system (SI)

1. Linear - centimeter, decimeter, meter
2. Capacity
 - a. Liter
 - b. Cup
3. Mass - gram, kilogram
4. Temperature - Celsius thermometer
- B. English system
 1. Linear - inch, foot, yard
 2. Liquid
 - a. Half-gallon, gallon
 - b. Half-pint, pint, quart
 - c. Cup
 3. Mass - ounce, pound
 4. Time - quarter hour, half-hour, hour
 5. Money
 - a. Cent, nickel, dime
 - b. Quarter, half-dollar, dollar
 6. Temperature - Fahrenheit thermometer
 7. Calendar
 - a. Days
 - b. Weeks
 - c. Months
- C. Estimation
 1. Nearest inch, foot, yard
 2. Nearest centimeter, decimeter, meter

V. Functions and Graphs

- A. Number pairs
- B. Pictographs
- C. Simple bar graphs

VI. Geometry

- A. Geometric shapes
 1. Circle
 2. Square
 3. Triangle
 4. Rectangle
- B. Lines and line segments
 1. Curves
 2. Closed, not closed
 3. Congruent curves
- C. Right angles

VII. Number Theory

- A. Number patterns
- B. Odd and even numbers

MATHEMATICS - GRADE THREE

The mathematics program in the third grade stresses computational skills and inverse relationships. It is important that the student at this level commits to memory the basic facts in addition, subtraction, multiplication, and division. Understanding place value in the base ten system and reading and writing large numbers should also be emphasized. Students should develop skills in using units of measurement and in recognizing and constructing geometric figures. The total third grade mathematics program should be a "doing" course where students explore, discover, and apply skills to practical life situations.

General Objectives

1. The student commits to memory the basic multiplication facts.
2. The student uses symbols to indicate operations, and to represent numbers.
3. The student increases his knowledge of the base ten system by reading, writing, and ordering numerals to 9999, using ordinals to hundredths, rounding numbers to the nearest ten and the nearest hundred, and comparing Roman numerals to the base ten system by reading and writing Roman numerals to L.
4. The student adds and subtracts three-digit numerals with regrouping and makes reasonable approximations of sums and differences.
5. The student discovers that addition and multiplication are commutative and associative.
6. The student demonstrates multiplication as repeated addition, and division as repeated subtraction. He also recognizes the role of one and zero in addition and multiplication.

7. The student multiplies and divides with one-digit multipliers and divisors.
8. The student increases his skill in solving problems involving money, approximations, and two-step operations.
9. The student names, uses, compares, and orders fractional numbers.
10. The student uses the English and the Metric system (SI) measurement.
11. The student interprets and constructs simple graphs.
12. The student identifies lines, line segments, rays, curves, angles, triangles, rectangles, squares, and quadrilaterals, and finds the perimeter of squares and rectangles.
13. The student identifies multiples of two through nine and number patterns in multiplication.
14. The student makes predictions and expresses the probability of an event as a fractional number.

GRADE THREE
PROGRAM OUTLINE

I. Numbers - Numeration

- A. Base ten
 - 1. Numerals to 9999 reads, writes, orders
 - 2. Ordinals to hundredth
 - 3. Many names for a number
 - 4. Rounding of numbers to nearest ten and nearest hundred
- B. Symbol perception
 - 1. The use of +, -, x, ÷, =, <, >, and ()
 - 2. Word sentences to number sentences and vice versa
- C. Roman numerals to L
- D. Symbol perception and vocabulary of sets
 - 1. Cardinal number of sets
 - 2. Equivalent sets
 - 3. Empty sets
 - 4. Subsets

II. Whole Numbers

- A. Operations
 - 1. Addition, subtraction, and properties
 - a. Basic facts
 - b. Language of addition and subtraction
 - c. Addition and subtraction as inverse operations
 - d. Addition and subtraction of three-digit numbers with and without regrouping
 - e. Commutative and associative properties of addition
 - f. Role of zero (0) in addition
 - g. Reasonable approximations of sums and differences
 - 2. Multiplication, division, and properties
 - a. Basic facts
 - b. Language of multiplication and division
 - c. Multiplication as repeated addition
 - d. Multiplication and division as inverse operations
 - e. Commutative and associative properties of multiplication
 - f. Role of one (1) in multiplication
 - g. Three-digit multiplicand and one-digit multipliers with and without regrouping
 - h. Division with one-digit divisors with two-digit quotients
 - i. Division as repeated subtraction
 - j. Reasonable approximations of products and quotients
- B. Application through problem solving
 - 1. Number sentences as models of problem situations
 - 2. Open-number sentences
 - 3. Problems involving money
 - 4. Problems involving approximations
 - 5. Two-step problems
 - 6. Use of <, >, or =

III. Fractional Numbers

- A. Common fractions
 - 1. Names and uses
 - 2. Symbols and terms
 - 3. Comparison and ordering with like denominators
 - 4. Equivalent fractions
- B. Decimal fractions
 - 1. Symbols
 - 2. Decimal to separate dollars and cents
 - 3. Problems involving money

IV. Measurement

- A. Metric system (SI)
 - 1. Linear
 - a. Kilometer
 - b. Centimeter, decimeter, meter
 - 2. Capacity
 - a. Liter
 - b. Milliliter
 - 3. Mass - gram, kilogram
 - 4. Temperature
 - a. Degrees Celsius
 - b. Freezing point, boiling point
 - c. Body temperature
 - 5. Problem solving
 - 6. Estimation
 - 7. Precision
- B. English system
 - 1. Linear
 - a. Mile
 - b. Quarter-inch, half-inch, inch, foot, yard
 - 2. Liquid
 - a. Half-gallon, gallon
 - b. Half-pint, pint, quart
 - 3. Mass - ounce, pound
 - 4. Time to the minute
 - 5. Temperature
 - a. Degrees Fahrenheit
 - b. Freezing point, boiling point
 - c. Body temperature
 - 6. Problem solving
 - 7. Estimation
 - 8. Precision

V. Functions and Graphs

- A. Number pairs
- B. Interpretation of bar graphs, double bar graphs, line graphs, and circular graphs
- C. Interpretation of pictographs

- D. Construction of simple maps, charts, and graphs
- E. Graph forms in four quadrants using directional terminology (N, S, E, and W)
- F. Interpretation of flowcharts
- G. Problem solving

VI. Geometry

- A. Lines, line segments, and rays
- B. Congruent shapes and segments
- C. Curves, angles, and polygons
- D. Right angle, triangle, rectangle, quadrilateral, and square
- E. Perimeter of square and rectangle
- F. Points inside, outside, and on a circle
- G. Lines of symmetry
- H. Geometric terms appropriate for level

VII. Number Theory

- A. Number patterns in multiplication
- B. Odd and even numbers
- C. Multiples of two through nine

VIII. Logic, Probability, and Statistics

- A. If-then, all, some, none statements
- B. Probability of an event as a fractional number
- C. Predictions

MATHEMATICS - GRADE FOUR

The major emphasis of the fourth grade mathematics program is on development and maintenance of computational skills. It is essential that all basic facts be committed to memory at this level. Also, the student should become proficient in the use of mathematical symbols and solving number sentences. He should increase his understanding of the base ten system through reading, writing, and ordering large numbers and using exponential notation. The student should become proficient in using metric units of measurement. The mathematics program should be approached realistically through application to life situations, and the total program should be one of discovery and "doing."

General Objectives

1. The student commits to memory basic multiplication and division facts.
2. The student becomes proficient in using numerical symbols for basic operations, number sentences, and designating kinds of sets.
3. The student furthers his understanding of the base ten system through reading, writing, ordering, and showing place value of numbers to billions, and using ordinals to thousandths.
4. The student compares the base ten system to the Roman system to M.
5. The student adds and subtracts four-place numbers with regrouping, multiplies by two-digit multipliers, divides by two-digit divisors, and finds the average of a set of numbers.
6. The student solves problems involving basic operations, money, approximations, and fractional numbers.

7. The student furthers his knowledge of fractional numbers by ordering fractions with unlike denominators, renaming equivalent fractions, adding and subtracting fractions with like denominators, and adding and subtracting mixed numbers with no renaming.
8. The student demonstrates his understanding of decimal fractions by showing place value and adding and subtracting simple decimal fractions.
9. The student increases his skill in estimation and precision measurement using the English system and the Metric system (SI).
10. The student interprets graphs, charts, diagrams, maps, and flow-charts and graphs data.
11. The student increases his knowledge of geometric figures.
12. The student finds perimeter of polygons and area of rectangles and squares.
13. The student increases his knowledge of number theory by finding prime and composite numbers and common multiples.
14. The student increases his understanding of logic and probability through diagrams and determines the probability of an event or paired event.

GRADE FOUR
PROGRAM OUTLINE

I. Numbers - Numeration

- A. Base ten
 - 1. Numbers to billions--reads, writes, orders
 - 2. Place value to nine digits
 - 3. Ordinals to thousandth
 - 4. Rounding of numbers to the nearest thousand
 - 5. Many names for a number
 - 6. Powers of ten
- B. Symbol perception
 - 1. Use of the symbols +, -, x, ÷, =, <, >, ()
 - 2. Word sentences to number sentences and vice versa
- C. Roman numerals to M
- D. Symbol perception and vocabulary of sets
 - 1. Equivalent sets
 - 2. Empty sets
 - 3. Union and intersection of sets
 - 4. Cardinal number of sets

II. Whole numbers

- A. Operations
 - 1. Addition, subtraction, and properties
 - a. Review of basic facts
 - b. Addition and subtraction of four-digit numbers with regrouping
 - c. Commutative and associative properties of addition
 - d. Estimating
 - 2. Multiplication, division, and properties
 - a. Review of basic facts
 - b. Multiplication of two-digit numbers with regrouping
 - c. Patterns for products using multiples of 10 and 100
 - d. Divisors which are multiples of 10 and 100
 - e. Two-digit divisors
 - f. Averages
- B. Application through problem solving
 - 1. Problems involving basic operations
 - 2. Two-step problems
 - 3. Problems with money using regrouping
 - 4. Problems using approximation
 - 5. Problems related to careers

III. Fractional Numbers

- A. Common fractions
 - 1. Ordering unit fractions
 - 2. As a form of division
 - 3. Renaming as equivalent fractions

4. Inverse relationship of addition and subtraction
 5. Addition and subtraction with like and unlike denominators
 6. Addition and subtraction of mixed numbers with no renaming
 7. Problem solving involving fractional numbers
- B. Decimal fractions
1. Place value
 2. Addition of two decimal fractions
 3. Problem solving involving addition of decimal fractions

VI. Measurement

- A. Metric system (SI).
1. Linear
Meter units - kilometer, hectometer, dekameter, meter, decimeter, centimeter, millimeter
 2. Capacity
Liter units - kiloliter, hectoliter, dekaliter, liter, deciliter, centiliter, milliliter
 3. Mass
Gram units - kilogram, hectogram, dekagram, gram, decigram, centigram, milligram
 4. Temperature
 - a. Degrees Celsius
 - b. Freezing point, boiling point
 - c. Body temperature
 5. Problem solving
 6. Estimation
 7. Precision
- B. English system
1. Linear
 - a. Mile
 - b. Quarter-inch, half-inch, inch, foot, yard
 2. Liquid
 - a. Half-gallon, gallon
 - b. Half-pint, pint, quart
 3. Mass - ounce, pound
 4. Time to the minute
 5. Temperature
 - a. Degrees Fahrenheit
 - b. Freezing point, boiling point
 - c. Body temperature
 6. Problem solving
 7. Estimation
 8. Precision
- C. Interpretation of a curve showing data on a number plane
- D. Interpretation of flowcharts
- E. Interpretation of maps, graphs, and charts

V. Geometry

- A. Lines, line segments, and rays
- B. Congruent angles and plane figures
- C. Right angles
- D. Perimeter of polygons
- E. Area of rectangles and squares
- F. Review of points inside, outside, and on a circle
- G. Lines of symmetry
- H. Recognition of geometric terms appropriate for this level

VI. Number Theory

- A. Number patterns in multiplication
- B. Prime and composite numbers
- C. Common multiples
- D. Factors, common factors, and greatest common factor

VII. Statistics, Probability, and Logic

- A. Diagrams for if-then, all, some, none, if-not, and then sentences
- B. Probability of an event named as zero or one
- C. Probability of paired events

MATHEMATICS - GRADE FIVE

The mathematics program for fifth grade reviews and extends the fundamental knowledge of each student in mathematics and emphasizes the importance of his active involvement. Special attention should be given to the reinforcement and extension of computational skills. Students at this level should have committed to memory the basic facts which are necessary for future success in mathematics.

General Objectives

1. The student extends his understanding of the decimal system by determining place value, interpreting symbols, and reading and writing large numbers.
2. The student increases his skill in the operations of addition, subtraction, multiplication, and division with whole numbers, rational fractions, and decimal fractions.
3. The student increases his knowledge of the English and Metric systems (SI) through estimation and measurement.
4. The student continues to interpret and draw simple line or bar graphs and pictographs.
5. The student recognizes, draws, and measures geometric shapes.
6. The student develops a meaningful approach to solving problems.

GRADE FIVE
PROGRAM OUTLINE

I. Numbers - Numeration

- A. Base ten
- B. Symbol perception
 - 1. Uses of the symbols +, -, x, ÷, <, >, ()
 - 2. Translation of number sentences
- C. Roman numerals
- D. History of mathematics and mathematicians

II. Whole Numbers

- A. Operations
 - 1. Addition, subtraction, and properties
 - a. Review of basic facts
 - b. Addition and subtraction of five-digit numbers with regrouping
 - c. Commutative and associative properties of addition
 - d. Rounding
 - 2. Multiplication and division
 - a. Review of basic facts
 - b. Division as inverse operation of multiplication
 - c. Three-digit multiplication
 - d. Division by three-digit divisors
 - e. Estimation of quotients and products
 - f. Role of zero and one in multiplication
 - g. Averages
- B. Application
 - 1. Word problems
 - a. Solution of given problems
 - b. Create word problems
 - c. Solve problems related to careers
 - 2. Two-step problems

III. Fractional Numbers

- A. Common fractions
 - 1. Equivalent fractions
 - 2. Improper and proper fractions
 - 3. Improper fractions as mixed numerals and mixed numerals as improper fractions
 - 4. Common denominators
 - 5. Addition, subtraction, and multiplication of fractions and mixed numerals
 - 6. Changes fractional numbers with denominators of multiples of ten to decimal fractions

B. Decimal fractions

1. Definition
2. Place value
3. Simple decimal fractions as common fractions and vice versa
4. Addition and subtraction
5. Number sentences

IV. Measurement

A. Metric system (SI)

1. Prefixes and symbols for one thousand times to one thousandth of base units
 - kilo - 1000x
 - hecto - 100x
 - deka - 10x
 - deci - 0.1x
 - centi - 0.01x
 - milli - 0.001x
2. The comparison of metric unit place values using prefixes
 - a. Linear units
 - kilometer - km
 - hectometer - hm
 - dekameter - dam
 - meter - m
 - decimeter - dm
 - centimeter - cm
 - millimeter - mm
 - b. Capacity
 - kiloliter - kL
 - hectoliter - hL
 - dekaliter - daL
 - liter - L
 - deciliter - dL
 - centiliter - cL
 - milliliter - mL
 - c. Mass units
 - kilogram - kg
 - hectogram - hg
 - dekagram - dag
 - gram - g
 - decigram - dg
 - centigram - cg
 - milligram - mg
3. Temperature - Celsius thermometer
4. History of measurement
5. Addition and subtraction of metric units

B. English system

1. Linear
 - a. Mile
 - b. Quarter-inch, half-inch, inch, foot, yard

- 2. Liquid
 - a. Half-gallon, gallon
 - b. Half-pint, pint, quart
- 3. Mass - ounce, pound
- 4. Temperature - Fahrenheit thermometer
- 5. Addition and subtraction of English units of measure
- C. Longitude and latitude

V. Functions and Graphs

- A. Number pairs
- B. Graphs - bar, double bar, line, and circle graphs

VI. Geometry

- A. Language
- B. Rectangle
- C. Circles
- D. Triangles
- E. Perimeter
- F. Area
- G. Properties of solid figures
 - 1. Rectangular figures
 - 2. Cones, spheres, cylinders, pyramids
- H. Lines
 - 1. Parallel
 - 2. Intersecting
 - 3. Slanting
 - 4. Perpendicular
 - 5. Symmetry
 - 6. Rays
 - 7. Angles
- I. Congruence

VII. Number Theory

- A. Number patterns
- B. Prime factorization
- C. Least common multiples, greatest common factors with fractions

MATHEMATICS - GRADE SIX

The mathematics program in the sixth grade builds on previous mathematical concepts. The teacher should diagnose, prescribe, evaluate, re-teach, and retest in efforts to meet individual needs. Students can be grouped according to need without working on a one-to-one relationship.

In the sixth grade, students need to review all previous concepts with emphasis on mastery of computational skills including three-place multipliers and divisors and multiplication and division of decimals and fractions. NOTE: *Topics in the outline are included for enrichment.

General Objectives

1. The student demonstrates a mastery of the computational skills.
2. The student builds on previous learnings in basic operations and demonstrates competency in applying these skills to meet the needs of everyday life.
3. The student demonstrates an understanding of the base ten numeration system through using large numbers and comparing the system to other numeration systems.
4. The student demonstrates a competency in operations involving fractional numbers.
5. The student applies his knowledge of decimal fractions in metric measurement and money situations.
6. The student compares numbers using ratios and solves proportions and percent problems.
7. The student collects and graphs data.
8. The student recognizes geometric figures and finds perimeter, area, volume, and circumference.

9. The student uses estimation and precision in measurement.
10. The student demonstrates his understanding of probability, logic, and statistics by making predictions, determining alternative courses, and graphing data.

GRADE SIX
PROGRAM OUTLINE

I. Numbers - Numeration

- A. Base ten
 - 1. Numerals to billions
 - 2. Place value as a power of ten
- B. Symbols perception
 - 1. Reviews application of symbols
 - 2. Word sentences to number sentences and vice versa
- C. Roman numerals - reviews numerals to M
- D. Sets
 - 1. Vocabulary
 - 2. Symbols
- *E. Number bases other than base ten
- *F. History - Hindu-Arabic and other mathematics developments
- *G. Creative activities
- *H. Creative word problems

II. Whole Numbers

- A. Operations
 - 1. Addition, subtraction, and properties
 - a. Review of basic number facts
 - b. Addition and subtraction to billions
 - c. Subtraction as inverse of addition
 - d. Commutative and associative properties of addition
 - e. Estimating
 - *f. Identity element
 - *g. Positive, negative numbers
 - 2. Multiplication and division
 - a. Review of basic number facts
 - b. Review of three-place multipliers and divisors
 - c. Division as inverse of multiplication
 - d. Commutative, associative, and distributive properties
 - e. Estimating
 - *f. Exponents
- B. Application through problem solving
 - 1. Word problems
 - a. Computation
 - b. Creation
 - 2. Simple horizontal equations
 - 3. Problems relating to careers

*Topics for enrichment

III. Fractional Numbers

- A. Common fractions
 - 1. Definition
 - 2. Operations
 - a. Addition and subtraction
 - (1) Least common denominator or multiple
 - (2) Lowest terms
 - b. Multiplication and division
 - (1) Fractions to lowest terms
 - (2) Fractions by whole numbers
 - (3) Whole numbers by a mixed number
 - (4) Fraction by a fraction
 - (5) Fraction by a mixed number
 - (6) Mixed number by a mixed number
 - (7) More than two factors
 - (8) Reciprocals in division
- B. Decimal fractions
 - 1. Definition
 - 2. Operations
 - a. Decimal fractions to common fractions and vice versa
 - b. Addition and subtraction
 - c. Multiplication and division
 - (1) Estimating and rounding answers
 - (2) Repeating decimals
 - 3. Application
 - a. Word problems
 - b. Decimals as used in metric system and monetary system
- C. Ratio and proportion
 - 1. Definition
 - 2. Operations
 - a. Ratio to compare two numbers
 - b. Equivalent ratios
 - c. Equality sign to show proportion
 - 3. Word problems using ratio and proportion
- D. Percent
 - 1. Definition and symbol
 - 2. Operation
 - a. Common fractions and ratios are equivalent percents
 - b. Percent of a number
 - c. One number as a percent of another number
 - d. Number when percent and percentage are known
 - *e. Computation of interest
 - 3. Application
 - a. Relevant word problems
 - b. Percent equations

IV. Measurement

- A. Metric system (SI)
 - 1. Definition
 - a. All previous units reviewed

*Topics for enrichment

- b. Hectare
 - c. Square meters
 - d. Square centimeters
 - e. Metric ton
- 2. Relationship of volume to capacity - relevant word problems
- 3. Relationship of weight to mass - relevant word problems
- 4. Relationship of the metric place value to our decimal and monetary system
- B. English system
 - 1. Definition of all previous standard units
 - 2. Precision, approximation, and "possible error" in measurement
- C. Time
 - 1. Longitude and latitude
 - 2. International date line
 - *3. Twenty-four-hour clock
- D. Application
 - 1. Word problems using all Metric units and English units
 - 2. Careers which involve measurement skills

V. Functions and Graphs

- A. Number pairs
- B. Graphs, scale drawings, charts, diagrams, and maps
 - 1. Data collection
 - 2. Data application

VI. Geometry

- A. Line segments and rays
- B. Congruence of segments
- C. Rays and angles
- D. Measurement of angles with a protractor
- E. Construction of angles and circles
- F. Polygons
- G. Perimeter
- H. Area
 - 1. Metric
 - 2. English
- I. Volume
 - 1. Metric
 - 2. English
- J. Properties of the circle - radius, diameter, circumference, area
- K. Congruent triangles

VII. Number Theory

- A. Number patterns
- B. Prime factorization
- C. Least common multiple and greatest common factor

*Topics for enrichment

VIII. Probability, Logic, and Statistics

- A. Probability of an event as a decimal or percent
- B. Prediction of averages--temperature, rainfall, etc.
- C. Counterexamples to show that an "all" or "none" sentence is false
- D. "If-then" sentences
- E. Mode and frequency
- F. Flowcharts

IX. Integers

- A. Location on a number line
- B. Recognition

MATHEMATICS - GRADE SEVEN

The basic concepts and skills developed in elementary school should be continued and reinforced in seventh grade mathematics. This course emphasizes the importance of developing sound mathematical concepts and skills in mathematics through experiences in problem solving and by relating mathematics to life situations. Emphasis should be placed on addition, subtraction, multiplication, and division of whole numbers, fractional (rational) numbers, decimal fractions and percent, sets, number theory, and the metric system.

General Objectives

1. The student identifies and uses set language and symbols.
2. The student uses the basic concepts of number theory involving exponents, prime and composite numbers, least common multiples, greatest common factor, cardinal and ordinal numbers, even and odd numbers, and counting numbers.
3. The student increases his computational skills for solving problems using whole numbers, decimal fractions, and common fractions.
4. The student names and estimates whole numbers and mixed decimal numbers to different place values.
5. The student interchanges common fractions, decimal fractions, and percents and solves problems using these.
6. The student interprets and draws graphs: bar, line segment, and circle.
7. The student names, identifies, constructs or draws angles, lines, polygons, circles, and solids.

8. The student states and uses formulas for measuring polygons, circles, and solids.
9. The student defines and uses units of length, capacity, mass, temperature, and time within the English and Metric (SI) system.
10. The student finds mean, median, and mode.
11. The student identifies the set of integers and performs the fundamental operations using the laws of signed numbers.
12. The student compares integers using the concepts and symbols of equality and inequality.

GRADE SEVEN
PROGRAM OUTLINE

- I. Number - Numeration
 - A. Symbol perception
 - 1. Reviews application of symbols
 - 2. Change from words to symbols and vice versa
 - B. History of numerals
 - C. Symbol perception and vocabulary of sets
 - D. Place value
- II. Whole Numbers
 - A. Vocabulary
 - B. Operations and properties
 - 1. Addition, subtraction
 - 2. Multiplication, division
 - 3. Estimation and approximation
 - C. Mathematical sentences using whole numbers
 - 1. Open sentences
 - 2. Equalities and inequalities
 - D. Expanded notation, base ten numerals
 - E. Problem solving
 - F. Exponents and scientific notation
- III. Fractional Numbers
 - A. Non-negative rational numbers
 - 1. Definition
 - 2. Ratio and proportion
 - 3. Operations and properties
 - 4. Symbol perception and vocabulary
 - 5. Mathematical sentences
 - 6. Using fractions to solve problems
 - 7. Estimation and approximation
 - B. Decimal fractions
 - 1. Definitions
 - 2. Symbol perception and vocabulary
 - 3. Place value
 - 4. Operations and properties
 - 5. Mathematical sentences
 - 6. Problem solving
 - 7. Estimating and approximating
 - 8. Rounding numbers (nearest decimal and whole number)
 - C. Percents
 - 1. Ratio and proportion
 - 2. Symbol perception and vocabulary
 - 3. Number sentences
 - 4. Business percent

5. Graphing - bar, line, circle graphs

IV. Measurement

- A. History
- B. Estimation
- C. Metric system (SI)
 - 1. Length
 - 2. Capacity
 - 3. Mass
 - 4. Temperature
 - 5. Area and volume
- D. English system
 - 1. Length
 - 2. Capacity
 - 3. Mass
 - 4. Temperature
 - 5. Area and volume
- E. Problem solving in both systems

V. Geometry

- A. Definition
- B. Vocabulary
- C. Angles and lines
 - 1. Identification
 - 2. Measurement
 - 3. Construction

VI. Number Theory

- A. Composite and prime numbers
- B. Least common multiples
- C. Greatest common factor
- D. Exponents
- E. Squares
- F. Square roots of perfect squares

VII. Statistics

- A. Mean
- B. Median
- C. Mode
- D. Graphing data

VIII. Integers

- A. Operation and properties
- B. Symbol perception and vocabulary
- C. Absolute value
- D. Exponents - scientific and expanded notations
- E. Number sentences

- F. Negative rational numbers (optional)
 - 1. Operation and properties
 - 2. Number sentences
- G. Graphing

MATHEMATICS - GRADE EIGHT

Eighth grade mathematics is a course which builds on groundwork laid in earlier grades. Although the student continues to develop speed and accuracy in computation, emphasis is placed on formal identification and use of previously developed concepts. The student should develop throughout the year the idea that mathematics is a unifying system, not a collection of unrelated ideas.

This outline contains more material than will be needed by some students. Suggestions and topics can be adapted to any textbook. Through the use of this guide the teacher can help the eighth grade student realize his full potential and open doors to new and more advanced mathematics courses.

A student on this level should master the four basic operations for whole numbers. This should prepare the student for rational numbers, sets, number theory, decimal fractions, percent, measurement, and the metric system. If these topics are completed, other topics from this outline could be used for supplementary material. It is suggested that each teacher teach reading in this content area through symbol perception and vocabulary as much as possible.

General Objectives

1. The student increases his computational skills for solving problems using whole numbers, decimals, and fractions
2. The student reads, writes, and interprets number names and operations using stated words and expanded notation.
3. The student applies problem solving skills in word problems related to real-life experiences.

4. The student interchanges fractional, decimal, and percent notations and solves word problems using these notations.
5. The student names and estimates whole and decimal numbers to a specified place value.
6. The student uses the basic concepts of number theory involving the following: exponents, prime numbers, least common multiple, greatest common factor, and divisibility rules.
7. The student identifies and uses set language and symbols.
8. The student names and identifies properties of angles, lines, polygons, and circles; also draws or constructs these figures.
9. The student uses formulas for finding the area and perimeter of the following geometric figures: square, rectangle, triangle, parallelogram; and area and circumference of a circle; also volume and surface area of solids.
10. The student defines and uses units of length, capacity, weight, or mass, and temperature within the English and Metric systems of measurement.
11. The student interprets graphs, gathers data, and records graphically.
12. The student identifies the set of integers and performs the four operations using the laws of signed numbers; compares integers using the concepts and symbols of inequality.
13. The student identifies the sides and hypotenuse of a right triangle; states the Pythagorean theorem and uses it for indirect measurement involving positive rational numbers.

GRADE EIGHT
PROGRAM OUTLINE

I. Numbers - Numeration

- A. Symbol perception
Translation of words into symbols and vice versa
- B. Systems of numbers
- C. History of mathematics
- D. Symbol perception and vocabulary of sets
- E. Place value in the decimal system

II. Whole Numbers

- A. Operations and properties
 - 1. Addition, subtraction
 - 2. Multiplication
 - a. Squares
 - b. Square roots
 - 3. Division
 - 4. Estimation
- B. Number sentences
 - 1. Equalities
 - 2. Inequalities
 - 3. Open sentences
- C. Problem solving using whole numbers
- D. Expanded notation, base ten numerals
- E. Exponents and scientific notation.

III. Fractional Numbers

- A. Non-negative rational numbers
 - 1. Definition
 - 2. Ratio and proportion
 - 3. Equivalent fractions
 - a. Greatest common factor
 - b. Least common multiple
 - 4. Operations and properties
 - 5. Number sentences
 - 6. Application through problem solving
 - a. Symbol perception
 - b. Vocabulary
- B. Decimal Fractions
 - 1. Definition
 - 2. Place values
 - 3. Operations and properties
 - 4. Number sentences
 - 5. Application through problem solving
 - a. Symbol perception
 - b. Vocabulary

6. Expanded notation (as a means of understanding place value)
7. Scientific notation
8. Repeating and non-terminating decimal
- C. Percent
 1. Definition
 2. Ratio and proportion
 3. Symbol perception and vocabulary
 4. Percents as decimals and fractions
 5. Number sentences
 6. Practical applications through problem solving
 7. Business percent
 8. Graphing (Interpretation and Construction)
 - a. Bar graphs
 - b. Line graphs
 - c. Circle graphs

IV. Measurement

- A. History of measurement, English and Metric
- B. Metric system
 1. Vocabulary of the metric system
 2. Linear, capacity, mass units
 3. Area
 4. Volume
 5. Temperature, Celsius
- B. English system
 1. Linear, capacity, weight units
 2. Area
 3. Volume
 4. Temperature, Fahrenheit
 5. Temperature, Celsius
- D. Time
- E. Estimation
- F. Greatest possible error (optional)
- G. Practical application in real-life experiences

V. Geometry

- A. Definition and applications
- B. Vocabulary
- C. Lines
 1. Parallel
 2. Perpendicular bisector of a line segment (construction)
 3. Perpendicular to a line at a point on the line (construction)
 4. Perpendicular to a line from a point not on the line (construction)
- D. Angles
 1. Measurement
 2. Construct an angle equal to a given angle
 3. Bisector of an angle
- E. Polygons
 1. Identification

- 2. Measurement
 - a. Perimeter
 - b. Area
- 3. Pythagorean theorem
- F. Circles
 - 1. Vocabulary
 - 2. Relationship of diameter to circumference
 - 3. Relationship of radius to area
- G. Solids (optional)
 - Surface area and volume
 - Cubes
 - Cylinders
 - Cones
 - Triangular solids

VI. Number Theory

- A. Prime numbers
- B. Composite numbers
- C. Patterns and relationships
- D. Prime factorization
- E. Factors - greatest common factor
- F. Multiples - least common multiple
- G. Divisibility tests
- H. Powers and roots

VII. Integers

- A. Operations and properties
 - 1. Vocabulary
 - 2. Symbol perception
 - 3. Patterns
- B. Number sentences
- C. Applications through problem solving
- D. As exponents - expanded notation
- E. Powers and roots (optional)

VIII. Negative Rational Numbers

- A. Definition
- B. Operations and properties
- C. Number sentences

IX. Statistics

- A. Definition
- B. Data collection
- C. Mean, median, mode
- D. Practical applications in real-life situations
- E. Graphing (interpretation and construction)
 - Circle, bar, and line graphs

X. Probability

- A. Vocabulary
- B. Sample space
- C. Independent events (optional)
- D. Dependent events (optional)
- E. Odds (optional)
- F. Practical applications in real-life experiences

XI. Trigonometry (Optional)

- A. Trigonometric ratios - sine, cosine, and tangent
- B. Using the tables for trigonometric ratios

PRE-ALGEBRA

Pre-Algebra is an optional, rigorous course for selected eighth grade students. The course includes a careful study of arithmetic with attention to both structure and skills. Topics include whole numbers, rational numbers, and concepts of relations and functions in preparation for the study of algebra. These topics, together with the associated skills, form an essential part of the mathematical background that all students will need as adults, while at the same time laying a solid foundation for any future work in mathematics.

General Objectives

1. The student increases proficiency in arithmetic computational skills through drill and problem solving.
2. The student develops skills in performing the four basic operations on signed numbers and in solving word problems involving simple equations and formulas.
3. The student uses the language of sets.
4. The student develops appreciation of the real numbers as well as the structured system when he uses the properties of the number operations to develop his skill with these operations.
5. The student begins an intuitive development of the abstractions of real number operations.
6. The student reads, writes, and interprets the symbols of algebra in problem solving.
7. The student solves word problems requiring linear equations in one variable over the set of real numbers.
8. The student recognizes the relationship between objects in the environment and geometric shapes.

PRE-ALGEBRA
PROGRAM OUTLINE

I. Language and Symbols of Mathematics

- A. Sets and how to represent them
- B. Kinds of sets
- C. Operations with sets
 - 1. Intersection
 - 2. Union

II. Basic Concepts About Numbers and Numerals

- A. Numbers, numerals, and the number line
- B. Number relationships
- C. Symbol perception and vocabulary
 - 1. Numeral expressions
 - 2. Equality statements

III. Whole Numbers

- A. Operations
 - 1. Addition and its inverse
 - 2. Multiplication and its inverse
- B. Properties
- C. Problem solving using equalities, inequalities, and open sentences

IV. Rational Numbers

- A. Non-negative rational numbers
 - 1. Operations and properties
 - 2. Number sentences
 - a. Equalities
 - b. Inequalities
 - c. Open
- B. Decimal fractions
 - 1. Operations and properties
 - 2. Number sentences
 - a. Equalities
 - b. Inequalities
 - c. Open
- C. Percent
 - 1. Ratio and proportion
 - 2. Percents as decimal numbers and common fractions
 - 3. Number sentences
 - a. Equalities
 - b. Inequalities
 - c. Open
- D. Practical applications through problem solving

V. Integers

- A. Integers and the number line
- B. Relationships to other sets of numbers
- C. Operations and properties
 - 1. Addition
 - 2. Subtraction
 - 3. Multiplication
 - 4. Division
- D. Number sentences

VI. Number Theory

- A. Patterns and relationships in numbers
- B. Prime and composite numbers
- C. Prime factorization
 - 1. Greatest common factor
 - 2. Least common multiple
- D. Divisibility tests
- E. Powers and roots
- F. Properties of zero and one

VII. Negative Rational Numbers

- A. Operations and properties
- B. Number sentences
 - 1. Equalities
 - 2. Inequalities
 - 3. Open

VIII. Equations in One Variable

- A. Writing word sentences as equations
 - 1. Punctuation
 - 2. Grouping
- B. Problem solving using inverse operations
- C. Combining similar terms
- D. Graphing solution sets

IX. Functions

- A. Definition
- B. Expressing functions - function notation
- C. Linear functions and their graphs
- D. Quadratic functions and their graphs (optional)

X. Basic Geometric Concepts

- A. Undefined terms using the ideas of sets
- B. Linear measure
- C. Angle measure
- D. Measurement of regions of the plane
- E. Measurement of regions in space

ALGEBRA I

The Algebra I course is a basic study in the structure of algebra and the development of the real number system. The set of rational numbers is studied in detail. The set of irrational numbers is discussed in relation to the total algebraic concepts. Emphasis is given to the basic properties and operations and their application to the set of real numbers. The proper balance between theoretical and practical application is projected through problem solving.

General Objectives

1. The student uses mathematical symbols, numbers, and numerals as they relate to signed numbers, sets, solution sets, and the evaluation of algebraic expressions.
2. The student uses properly the postulates and properties of operations in solutions of equations and problems of first degree.
3. The student performs basic operations with monomials and polynomials.
4. The student solves equations, inequalities, and problems containing one variable.
5. The student solves equations and problems involving special products, factoring, fractions, and inequalities involving fractions.
6. The student graphs functions and solution sets.
7. The student finds solutions to and graphs linear open sentences in one and two variables using real numbers.
8. The student solves equations and word problems involving all forms of quadratic equations.

ALGEBRA I
PROGRAM OUTLINE

- I. Symbols, Numbers, and Numerals
 - A. Symbols and numerals
 - B. Numbers and the number line
 - C. Order of operations
 - D. Use of other mathematical symbols
- II. Signed Numbers
 - A. Use of signed numbers to represent opposite values
 - B. Absolute value
 - C. Use of signed numbers in fundamental operations
- III. Open Phrases, Open Sentences, and Solution Sets
 - A. Algebraic vocabulary expansion
 - B. Open sentences and solution sets
 - C. Translation of worded expressions into algebraic language and their simplification
- IV. Operations with Monomials and Polynomials
 - A. Addition and subtraction
 - B. Multiplication
 - C. Division
- V. Postulates and Properties of Operations
 - A. Axioms of equality
 - B. Closure property
 - C. Commutative property
 - D. Associative property
 - E. Identity property
 - F. Distributive property
- VI. Simple Equations, Inequalities, and Problems
 - A. Solution of simple equations
 - B. Writing word sentences as equations
 - C. Evaluation of formulas as equations
 - D. Solution of inequalities
- VII. Word Problems Using One Variable
 - A. Vocabulary development
 - B. Analysis of English sentences
 - C. Types of word problems
 - D. Algebraic solutions

VIII. Special Products and Factoring

- A. Product of two binomials
- B. Cube of a binomial
- C. Factoring
- D. Use of factoring to solve second degree equation containing one variable

IX. Operations with Fractions

- A. Review of arithmetic fractions and their expansion to include algebraic fractions
- B. Writing equivalent algebraic fractions
- C. Multiplication and division of algebraic fractions
- D. Addition and subtraction of algebraic fractions
- E. Simplification of mixed expressions and complex fractions

X. Algebraic Sentences Involving Fractions

- A. Solution of equations and inequalities involving fractions
- B. Solution of word problems

XI. First Degree Equations and Inequalities Containing Two Variables

- A. Graphing a linear equation in two variables
- B. Graphic and algebraic solutions of systems of linear equations and inequalities

XII. Real Numbers

- A. Subset of real numbers
- B. Subset of irrational numbers
- C. Solution of radical (irrational) equations

XIII. Quadratic Equations

- A. Standard form of quadratic equation
- B. Graphic and algebraic solution of a quadratic equation containing one variable
- C. Solution of word problems which are translated into quadratic equations

GENERAL MATHEMATICS

The purposes of this course are (1) to teach or reteach computational skills involving whole, fractional, and decimal numbers; (2) to survey some of the other areas of mathematics like geometry, measurement, probability, statistics, and elementary algebra; and (3) to examine some of the applications of mathematics. Completion of this course by a student satisfies the State requirement for high school graduation by providing one mathematics unit. For some students lacking algebra readiness this course may serve the purpose of developing skills necessary for a student to follow with an algebra course.

If General Mathematics is to be limited to remedial arithmetic, then major emphasis should be placed on the first three headings in the content outline. Additional headings in the outline will extend and reinforce the basic course.

The prerequisite is that the student has completed eighth grade. This course may be taught at grades nine through twelve. The credit obtained is one-half unit per semester.

General Objectives

1. Provide experiences which will enable students to become proficient in the basic computational skills involving whole numbers, fractions, and decimals.
2. Explore some of the basic concepts of the geometry of two and three dimensions.
3. Make use of some basic concepts of number theory as a means of developing an understanding of the important properties of the whole numbers.

4. Provide experiences which will enable students to become proficient in estimating answers and doing mental arithmetic.
5. Present experiences in ratio and proportion and then use these in solving problems involving percentage and similar triangles.
6. Explore some of the elementary principles of probability and statistics.
7. Extend the students' knowledge of numbers to the integers. Then explore the addition, subtraction, multiplication, and division of integers.
8. Develop the ability to solve linear equations and inequalities.
9. Present problems, both real and contrived, which can be solved by means of equation solving.
10. Emphasize problem solving techniques.
11. Present arithmetic concepts in a non-traditional manner and on a level in keeping with the maturity of these students.
12. Examine some of the applications of mathematics which make use of the mathematics explored in this course.

GENERAL MATHEMATICS

PROGRAM OUTLINE

I. Whole Numbers

- A. Addition
- B. Subtraction
- C. Multiplication
- D. Division
- E. Estimation and approximation
- F. Raising to a power
- G. Finding the root of a number
- H. Applications involving whole numbers

II. Fractional Numbers

- A. Addition
- B. Subtraction
- C. Multiplication
- D. Division
- E. Estimation and approximation
- F. Basic operations involving mixed numerals
- G. Applications involving fractional numbers

III. Decimals

- A. Addition
- B. Subtraction
- C. Multiplication
- D. Division
- E. Estimation and approximation
- F. Applications involving decimals

IV. Integers

- A. Meaning and representation of integers on a number line
- B. Addition
- C. Subtraction
- D. Multiplication
- E. Division
- F. Applications involving integers

V. Informal Geometry

- A. Geometry of two dimensions
- B. Geometry of three dimensions
- C. Applications of geometry

VI. Linear Equations and Inequalities

- A. Solving equations by addition
- B. Solving equations by subtraction
- C. Solving equations by multiplication
- D. Solving equations by division
- E. Solving equations involving more than one operation
- F. Problem solving involving equations
- G. Solving linear inequalities

VII. Measurement Involving Both the Metric and Customary Units
(Taught Separately)

- A. Linear units
- B. Area
- C. Volume
- D. Mass
- E. Capacity (liquid)
- F. Temperature
- G. Practical applications

VIII. Probability and Statistics

- A. Gathering data including sampling
- B. Analyzing data
- C. Reporting data including histograms and graphs
- D. Probability of an event

IX. Ratio and Proportion

- A. Using ratios and proportions to solve problems
- B. Scale drawings
- C. Percent as a ratio

CONSUMER MATHEMATICS

The purpose of the Consumer Mathematics course is to provide students with basic competencies necessary for economic survival in our highly competitive, modern society. The ability range of students enrolling in Consumer Mathematics may be from those lacking but seeking basic skills in arithmetic to those intentionally working to further their interests and abilities in consumer related applications of mathematics.

The ability to read and interpret intelligently statistical data, word problems, advertisements, and the like is a fundamental skill underlying attainment of basic economic survival competencies. Teachers must be particularly attuned to the need to stress reading in the mathematics content area.

This is a mathematics course and not an economics or reading course. Primary emphasis should be on the practical application of mathematics in everyday economic situations, but computation and mathematics theory should not be neglected.

General Objectives

1. Investigate the functions of a bank and the services a bank provides consumers.
2. Perform the following tasks: (a) open an account; (b) write a check; (c) determine a balance; (d) make out a deposit ticket; and (e) reconcile a bank statement.
3. Investigate the interrelationships of credit and the nation's economy.
4. Perform the following tasks: (a) determine the amount of interest on credit; (b) compute the rate of interest; (c) find the difference

between the costs of various credit plans; and (d) compute gross, net or disposable income, and discretionary income.

5. Identify variations in housing needs and the factors influencing them.
6. Perform the following tasks: (a) find the difference between the purchase price of a home and the cost of owning and maintaining a home; (b) use interest tables to derive the purchase price of a house under different mortgage plans; (c) find variations in mortgage costs as determined by the number of payments, interest rate, and amount of the loan; (d) make a scale drawing of a floor plan; and (e) estimate the costs of simple home repairs, renovations, and utilities.
7. Identify various forms of insurance along with the purposes, advantages, and disadvantages of each.
8. Identify factors which are used in determining premium rates of insurance policies.
9. Use tables to determine: (a) the costs of various types of insurance, and (b) the amount of an employee's current FICA tax contribution.
10. Investigate the elementary concepts of probability and statistics that affect the typical consumer, in particular, how sampling techniques and graphs can be used to present a biased picture.
11. Perform activities in probability and statistics which will make the student better aware of these important branches of mathematics.
12. Identify various forms of taxation as well as the derived benefits from tax dollars.
13. Perform the following tasks: (a) complete state and federal tax forms; (b) compute direct and indirect taxes on specified items; and (c) keep records for making tax reporting easier.

14. Investigate the various modes of transportation and the advantages and disadvantages of each.
15. Identify the costs other than purchase cost relative to automobile ownership, operation, and maintenance, and determine the aggregate cost.
16. Investigate various schemes used to defraud the public and the agencies which can be called upon to assist a victim of fraudulent practices.

CONSUMER MATHEMATICS

PROGRAM OUTLINE

- I. Banks and Their Services
 - A. Types of banks
 - B. Bank services
- II. Consumer Credit
 - A. Using credit
 - B. Kinds of credit plans
 - C. Cost of consumer credit
 - D. The credit contract
 - E. Legal aspects
- III. Housing
 - A. Buying a house, condominium, and mobile home
 - B. Renting a house, apartment, and mobile home
- IV. Insurance
 - A. Basic kinds of insurance
 - B. Buying insurance
- V. Probability and Statistics
 - A. Probability
 - B. Statistical data
 - 1. Collection
 - 2. Analysis
- VI. Money Management
 - A. Income
 - B. Budgets
 - C. Buying practices
 - D. Consumer protection
- VII. Savings and Investments
 - A. Savings
 - B. Investments
- VIII. Taxes
 - A. Federal income tax
 - B. State income tax

- C. Property taxes
- D. Other taxes: sales, excise, inheritance, gift, use, and intangible

IX. Swindles and Gyps

- A. Deceptive advertising
- B. Deceptive pricing
- C. Business opportunity schemes
- D. Home improvement schemes
- E. Referral schemes
- F. Vacation schemes
- G. Games of chance
- H. Charity collections
- I. Self-improvement schemes
- J. Flimflam
- K. Worthless stocks and bonds
- L. Land sales
- M. Family swindles

X. Transportation

- A. Personal transportation
 - 1. Purchasing, leasing, and renting a vehicle
 - 2. Continuing costs
 - 3. Insurance
- B. Trip planning
- C. Specialized recreational vehicles

APPLIED VOCATIONAL MATHEMATICS

The purpose of Applied Vocational Mathematics is to teach and show the application of mathematical principles to a wide range of career fields. Each section of the course outline should be taught as a practical and useful means of achieving success in a variety of vocations.

Reading, writing, and arithmetic are basic entry skills for almost every conceivable job. Teachers will have to resort to many material and personnel resources outside of the normal textbook in order to create career awareness and to demonstrate the relevance of mathematics to everyday life situations.

General Objectives

1. To use applications from the vocations as a vehicle for developing and reinforcing students' backgrounds.
2. To present mathematical problems as they exist in a real-life setting with which students can relate.
3. To familiarize students with some of the technical vocabulary used in various vocations.
4. To acquaint students with some of the mathematical concepts and skills needed for selected vocations.

Specific Objectives

1. Review and reinforce computational skills involving whole numbers, fractions, and decimals.
2. Extend computations involving fractions and decimals to include percents.
3. Develop equation and formula solving facility.

4. Provide opportunities for measurements with the Metric and U. S. Customary systems using basic formulas to compute linear, area, and volume measures of various geometric figures.
5. Develop an understanding of some of the elementary concepts of geometry. Use these concepts to help solve problems related to layout, sketching, and scale drawings.
6. Use the Pythagorean theorem to solve problems.
7. Read and interpret bar, line, and circle graphs.
8. Construct bar, line, and circle graphs as a means of communicating information.
9. Apply the ideas of ratio and proportion to help solve real or contrived problems.
10. Read and use mathematical tables.

NOTE: As mathematical ideas are presented, opportunities should be provided to apply these to problems from various vocations.

APPLIED VOCATIONAL MATHEMATICS

PROGRAM OUTLINE

- I. Whole Numbers
 - A. Applications involving whole number operations as used in various trades and industries
 - B. Estimating answers
- II. Fractions
 - A. Applications from various trades and industries
 - B. Fractions as percents
 - C. Estimating answers
- III. Decimals
 - A. Applications from various trades and industries
 - B. Decimals as percents
 - C. Estimating answers
- IV. Equations
 - A. Using informal techniques to solve equations
 - B. Using addition, subtraction, multiplication and division to solve equations
 - C. Applications from various trades and industries
- V. Formulas
 - A. Working with formulas
 - B. Using formulas from various vocations
- VI. Geometry
 - A. Angles
 - B. Plane figures
 - C. Three-dimensional figures
 - D. Constructions
 - E. Applications
 - F. Pythagorean theorem
- VII. Measurement Involving Both the Metric and Customary Units (Taught Separately)
 - A. Linear units
 - B. Area
 - C. Volume
 - D. Mass
 - E. Capacity

- E. Capacity (liquid)
- F. Temperature
- G. Practical applications

VIII. Graphs

- A. Bar
- B. Line
- C. Circle
- D. Interpreting and drawing inferences from graphs
- E. Constructing graphs
- F. Applications

IX. Scale Drawings

- A. Ratio
- B. Proportion
- C. Similarity
- D. Applications

X. Trigonometry of the Right Triangle

- A. Sine, cosine, and tangent ratios
- B. Using trigonometric tables
- C. Using sines, cosines, and tangents in problem solving

ALGEBRA II

Algebra II is a continuation of the study of the real numbers system and functions begun in Algebra I. Emphasis should be placed upon understanding algebraic structure as well as extending understanding of algebraic techniques.

Algebra II is a rigorous and formal course and teachers should use every means to illustrate meaningful applications of algebra to biological, physical, and social sciences. Deductive reasoning should be utilized whenever possible.

General Objectives

1. To provide a review of previously introduced algebraic topics as they relate to the structure of the real number system.
2. To consider the role of deductive reasoning in algebra and to apply this in the manipulative techniques used in algebra.
3. To use the basic ideas of sets to define and to explain algebraic concepts.
4. To review and to extend the concept of open mathematical sentences, and systems of sentences, involving inequality as well as equality.
5. To use one, two, and three-dimensional coordinate systems to represent graphically various mathematical relationships.
6. To strengthen understanding of relations and functions and to use these ideas throughout the course.
7. To teach in-depth linear and quadratic functions and relations.
8. To extend the laws of exponents to include rational and irrational exponents.

9. To develop logarithms from exponents and to develop skill in using logarithmic and exponential functions.
10. To teach the fundamental ideas of numerical trigonometry of the general angle.

ALGEBRA II
PROGRAM OUTLINE

- I. Sets of Numbers
 - A. Natural numbers
 - B. Integers
 - C. Rational numbers
 - D. Irrational numbers
 - E. Complex numbers
- II. Relations
 - A. Definitions and notations
 - B. Linear and quadratic functions
 - C. Inverse of a relation
 - D. Direct, inverse, and joint variation
- III. Polynomials and Rational Fractional Expressions
- IV. Algebraic Equations and Inequalities Involving One Variable
 - A. Solution of quadratic equations
 - B. Solution of special higher degree polynomial equations
 - C. Solution of special irrational equations
 - D. Solution of quadratic inequalities
- V. Systems of equations and inequalities
 - A. Solutions of systems of linear equations and inequalities by linear combinations, substitution and graphs
 - B. Determinants
 - C. Solutions of systems of linear equations using determinants
 - D. Solutions of systems involving linear and quadratic equations in two variables
- VI. Exponential and Logarithmic Functions
 - A. A review of integral and rational exponents and the extension of the concept to include any real exponents
 - B. Exponential functions and equations
 - C. The logarithm of a number to a base "a" as the inverse of an exponential function
 - D. Properties of logarithms and computation using logarithms
 - E. Solutions of exponential and logarithmic equations and inequalities
- VII. Trigonometric Functions
 - A. Radian measure
 - B. Definition of certain quotient functions

- C. Reference angle
- D. Periodicity
- E. Complementary angles
- F. Complementary functions
- G. Use of trigonometric tables
- H. Graphs of the basic trigonometric functions (cosine, sine, tangent, secant, cosecant, cotangent) through one complete period
- I. Use of trigonometric functions to determine components of vector quantities
- J. Pythagorean identities
- K. Law of Cosines
- L. Law of Sines
- M. Formulas for sums and differences of angles
- N. Solutions of trigonometric equations and proof of trigonometric identities
- O. Solutions of triangles
- P. Inverse trigonometric relations and functions
- Q. Algorithms with complex numbers using polar form
- R. DeMoivre's Theorem (proof optional)

VIII. Complex Numbers

- A. Sums, products, differences, quotients, powers and roots of complex numbers in rectangular form
- B. Fundamental operations with complex numbers in exponential form

IX. Sequences and Series

- A. Sequences and series
- B. Progressions and sums of progressions

X. Mathematical Induction (Optional)

XI. Probability (Optional)

- A. Permutations and combinations
- B. Binomial Theorem and Binomial Series
- C. Probability

XII. Matrices (Optional)

- A. Symbolism used with matrices
- B. Special kinds of matrices
- C. Definition of the sum of certain kinds of matrices
- D. Definition of the product of certain kinds of matrices
- E. Properties of addition and multiplication of matrices
- F. Applications

UNIFIED GEOMETRY

The development of geometry proceeds from the intuitive ideas of Euclidean geometry to formal proofs of postulates together with theorems that may be derived from them by application of logic. The idea of replacing the Euclidean parallel postulate leads to the probability of non-Euclidean geometries such as hyperbolic and elliptic geometries. The Unified Geometry includes each of these but is primarily Euclidean geometry. It emphasizes geometry as a deductive mathematical system--a system in which many results are logically deduced from some accepted assumptions and basic terms. Algebra I is a prerequisite because algebraic skills are reviewed and applied to problems solving in geometry, concepts of space, and the rectangular coordinate system is integrated with the study of plane geometry. In addition to the basic development of geometry the course includes constructions, loci, transformations, and the trigonometric relations which are developed in the right triangle. By using the laboratory approach in the teaching of geometry the teacher can use a great variety of instructional possibilities such as physical facilities or equipment in the classroom, community resources, and involve students in a "learning-by-doing" situation.

General Objectives

1. The student recognizes that a mathematical system contains undefined terms, basic definitions, postulates, and statements to prove.
2. The student reads and uses the algebraic and basic geometric symbols.
3. The student uses induction as a method of discovery and deduction as a method for proof of new ideas and selects examples as representative of each method of learning.

4. The student states and applies some initial postulates and theorems working with angles and perpendicular lines.
5. The student demonstrates competency in the writing of a formal proof using the model consisting of five parts with logical statements and reasons.
6. The student distinguishes between parallel and skew lines and names and evaluates the angles formed by transversal of parallel lines.
7. When given a correspondence or a congruence statement about two triangles, the student identifies the six pairs of corresponding parts.
8. The student selects the correct postulate for proving triangles congruent and writes a two column proof using it.
9. The student applies the theorem about congruent triangles in proofs and numerical exercises in other polygons.
10. The student states and applies the Pythagorean theorem and its converse in expressing relationship between sides and angles in right triangles.
11. The student solves a right triangle problem by correct selection and use of the tangent, sine, and cosine ratios.
12. The student uses the properties involving circles, angles, and line segments related to circles in proofs and computational exercises.
13. The student computes the areas of triangles, parallelograms, and trapezoids using the formulas derived from the postulates for the area of a rectangle.
14. The student performs fifteen basic constructions and applies the knowledge of these in original construction exercises.

15. The student represents coordinates and algebraic equations as points and lines in a plane and uses the distance formulas.
16. The student recognizes and uses the terms mapping, image, congruence mapping, isometry, transformations, and the properties of reflections and half-turns.
17. The student shows improved patterns of independent, creative, and cultural thinking.

UNIFIED GEOMETRY

PROGRAM OUTLINE

I. Introduction to Concepts of Geometry

- A. Elements of Geometry
 - 1. Geometries
 - a. Euclidean
 - b. Non-Euclidean
 - 2. Key mathematical ideas
 - a. Undefined terms
 - b. Basic definitions
 - 3. Sets and logic
 - a. Language of sets
 - b. Principles of logic
- B. Geometry as a logical system
 - 1. Induction, a method of discovery
 - 2. Deduction, a method of proof
 - 3. Introduction to a formal geometric proof
- C. Algebraic skills reviewed
 - 1. Algebraic symbols and language
 - 2. Real numbers and their properties
 - 3. Operations with algebraic expressions
- D. Constructions in Geometry
 - 1. Tools of construction
 - 2. Basic constructions
 - a. Parallel lines
 - b. Perpendicular lines
 - c. Equal line segments

II. Introduction to Points, Lines, and Planes

- A. Intuitive ideas and undefined terms
- B. Basic definitions
- C. Postulates and theorems
- D. Symbols and notations
 - 1. Algebraic
 - 2. Geometric
- E. Expressed relations
 - 1. In coordinate systems
 - 2. Using sets and subsets
- F. Line segments and rays

III. Introduction to Angles

- A. Measurement of angles
- B. Classifications of angles

- C. Special relation between pairs of angles
 - 1. Adjacent angles
 - 2. Vertical angles
 - 3. Complementary
 - 4. Supplementary
 - D. Congruence of angles
 - E. Initial proofs relating to angles
 - 1. Differences between direct and indirect proof
 - 2. Application of elementary logic to proofs
- IV. Special Relations of Lines and Planes
- A. Parallel lines and planes
 - 1. Constructions showing relationship
 - 2. Identification of angles formed by transversal of parallel lines
 - 3. Proving lines parallel
 - 4. Parallelism in non-Euclidean geometry
 - B. Perpendicular lines and planes
 - 1. Construction of perpendicular lines
 - 2. Proving lines perpendicular
 - 3. Application of theorems
 - 4. Perpendicular lines in a plane
- V. Triangles
- A. Classification of triangles
 - 1. According to sides
 - 2. According to angles
 - B. Congruence of triangles
 - 1. Correspondence of parts of triangles
 - 2. Postulates of congruence
 - 3. Original proofs and exercises
 - C. Similarity of triangles
 - 1. Similarity and proportionality of sides of triangle
 - 2. Congruence and similarity
 - 3. Equivalence relationship
 - D. Application of congruency
 - 1. Sum of angles of a triangle
 - 2. Construction of congruent triangles
 - E. The Pythagorean theorem
 - 1. Algebraic proof
 - 2. Converse of Pythagorean theorem
- VI. Application of Congruent Triangles
- A. Quadrilaterals
 - 1. Parallelograms
 - 2. Rectangles
 - 3. Rhombuses
 - 4. Trapezoids
 - B. Other Polygons
 - C. Inequalities in triangles

VII. Similar Polygons

- A. Definitions and properties
- B. Ratio and proportion
- C. Special right triangle
 - 1. 30-60-90 degree triangles
 - 2. 45-45-90 degree triangles
- D. Trigonometry
 - 1. Trigonometric relations in a right triangle
 - 2. Law of Sines and Cosines
 - 3. Application to solution of practical problems
- E. Areas of polygons
 - 1. Area of polygonal regions
 - 2. Formulas for areas of polygons

VIII. Circles

- A. Line segments related to circles
 - 1. Tangents
 - 2. Chords
 - 3. Secants
 - 4. Inscribed polygons
 - 5. Circumscribed polygons
- B. Angles and line segments
 - 1. Central angles
 - 2. Inscribed angles
- C. Measurement of circles
 - 1. Area
 - 2. Circumference
- D. Conic sections
 - 1. Ellipses
 - 2. Parabolas
 - 3. Circles
 - 4. Hyperbolas

IX. Geometric Solids

- A. Individual properties
 - 1. Cylinders
 - 2. Polyhedrons
 - 3. Prisms and parallelpipeds
 - 4. Cones and pyramids
 - 5. Spheres
- B. Formulas
 - 1. Area
 - 2. Volume
- C. Application to practical problems

X. Locus

- A. Introduction
 - 1. Conditions determining a figure
 - 2. Describing a locus

- B. Basic locus theorem
- C. Intersections of loci
- D. Locus in three dimensions
- E. Points of concurrency in a triangle
 - 1. Altitudes
 - 2. Medians
 - 3. Angle Bisectors
 - 4. Centroid

XI. Coordinate Geometry

- A. The coordinate plane
- B. The distance formula
- C. Representation of lines and planes in coordinate planes by algebraic equations
- D. Proofs using coordinate methods

XII. Transformations

- A. Basic mappings
 - 1. Congruence mapping
 - 2. Isometry and transformations
- B. Composite mapping
 - 1. Rotations
 - 2. Translations
 - 3. Dilations
 - 4. Reflections

INTRODUCTORY ANALYSIS

Introductory Analysis is designed as a pre-calculus course for the college-bound student, with emphasis upon mathematical logic, the examination of the number systems of mathematics, and the study of relations and functions. Prerequisites are Algebra I, Geometry, and Algebra II.

The basic course content includes logical inference; mathematical induction; sequences, series, and limits; vector algebra; polynomial functions; exponential and logarithmic functions; circular and trigonometric functions and matrix algebra. Optionally, topics from probability or analytic geometry could expand the course content.

General Objectives

The student should:

1. Observe and trace the patterns in a mathematical system which reflect the structure of that system and tend to unify all systems of mathematics.
2. Recognize validity in argument and express supporting statements of proof in the language of logical inference.
3. Respect precision and clarity of language and mathematical symbolism in interpretation and written expressions.
4. Acknowledge the dramatic effect of calculators upon business, industry, and educational techniques and acquire some personal capability with computational devices.
5. Reconstruct the real number field from known properties and axioms and test abstract number systems for these characteristics.
6. Represent a physical quantity as an ordered pair of real numbers and compute vector information.

7. Translate the algebra of vectors into geometric terms and prove that the algebraic properties correlate with the geometric ones.
8. Verify that the set of complex numbers is algebraically complete and that polynomials are factorable because of the fundamental theorem of algebra.
9. Describe a function as a mapping of a domain set into a range, or inversely, using the intersection of the real number domains.
10. Observe the behavior of a continuous and differentiable function at a particular point, writing the equation of the line tangent to the curve.
11. Perceive the power of mathematics as an organized science and appreciate the depth of application of mathematical principles to all "life" situations.

INTRODUCTORY ANALYSIS

PROGRAM OUTLINE

- I. Introduction to Logical Inference
 - A. Algebraic review
 - B. Quantifiers and variables
 - C. Negations
 - D. Complements
 - E. Compound statements and biconditionals
 - F. Truth tables
 - G. Terminology and patterns of logical inference
- II. Ordered Number Fields
 - A. Field properties with a binary operation
 - 1. Closure
 - 2. Associativity
 - 3. Existence of identities
 - 4. Existence of inverses
 - 5. Commutativity
 - 6. Distributivity
 - B. Semigroups, groups, and Abelian groups
 - C. Axioms of equality
 - D. Axioms of order
 - E. Algebraic proofs by field properties
 - 1. Cancellation law for addition
 - 2. Cancellation for multiplication
 - 3. Principle of indirect inference
- III. Sequences, Series, and Limits
 - A. Principle of mathematical induction
 - B. Sequences
 - 1. Arithmetic progressions
 - 2. Geometric progressions
 - C. Series
 - 1. Expansion and summation
 - 2. Arithmetic series
 - 3. Infinite geometric series
 - D. Binomial theorem
 - E. Limit of a sequence - sequence of partial sums
- IV. Vectors
 - A. The algebra of vectors
 - 1. Points and ordered pairs
 - 2. Displacements
 - 3. Vector sums and differences
 - 4. Vector norms

5. Multiplication by a scalar
6. Unit vectors
7. Inner products
8. The triangle inequality
9. Parallel and perpendicular vectors
10. Perpendicular components of vectors
- B. Vectors and lines in a plane
 1. Vectors as points in a plane
 2. Lines in a plane
 3. Vectors equations
 4. Parameters
 5. Coincidence, parallelism, and collinearity
 6. Distance between a point and a line
 7. Intersection of lines
 8. Slope forms for lines
- V. Complex Numbers
 - A. Vector representation
 - B. Operations with complex numbers
 1. Addition and multiplication
 2. Square roots
 - C. Fundamental theorem of algebra
Factorable polynomials with real coefficients
 - D. Relationship between roots and coefficients of polynomials
- VI. Polynomial Functions
 - A. Linear relations
 - B. Functions as mappings - signum, greatest integer, and absolute value functions
 - C. The arithmetic of functions
 1. Equality
 2. Sums, products, and powers
 - D. The arithmetic of polynomials
 1. Sums and products
 2. Remainder theorem
 - E. Synthetic division and the factor theorem
 - F. Rational root theorem
 - G. Bounds for real roots
 - H. Descartes rule of signs
- VII. Graphs of Polynomial Functions
 - A. Curve sketching
 - B. Limits and continuity of functions
 - C. The location principle
 - D. Equations of lines tangent to curves
- VIII. Derivatives
 - A. Derivatives of continuous and differentiable polynomials

- B. Graphing of derivatives
 - 1. Relative maxima
 - 2. Relative minima
 - 3. Inflection points
 - 4. Concavity
- C. Application of derivatives
- D. Newton's method for approximating zeros

IX. Exponential and Logarithmic Functions

- A. Laws of exponents extended to real numbers
- B. Continuity of exponential functions
- C. Linear interpolation of exponential function values
- D. Inverse functions
- E. Laws of logarithms
- F. Computation with logarithms
- Linear interpolation of logarithmic values

X. Circular and Trigonometric Functions

- A. Trigonometric functions of angles in standard position
 - Ratios of the right angle
- B. Interpolation of trigonometric table values
- C. Polar coordinates
- D. The unit circle and wrapping functions
- E. Trigonometric functions defined in the unit circle
- F. Graphs of periodic functions
 - 1. Amplitude
 - 2. Period
 - 3. Phase shift
- G. Interpretation of circular functions
- H. Inverse circular functions and principle values

XI. Trigonometric Identities

- A. Fundamental identities
- B. Sums and difference formulas
- C. Half-angle and double-angle formulas
- D. Reduction formulas
- E. Law of Cosines
- F. Law of Sines
- G. DeMoivre's theorem

XII. Matrices

- A. Linear transformations
 - 1. Translations
 - 2. Rotations
 - 3. Transformation of points
- B. Matrix dimensions
- C. Sums and differences of two matrices

- D. Products of a matrix and a scalar
- E. Products of two matrices
- F. Properties of matrix addition and multiplication

COMPUTER PROGRAMMING

Computer programming is designed to familiarize the student with the development of computers, their impact on the advancement of technology, and their many uses in solving problems in mathematics, science, business, and other disciplines. Emphasis is placed on analyzing problems, designing algorithms and flowcharts preparatory to writing and executing programs, and analyzing results. Also stressed is the combined use of mathematics and the computer in developing systematic procedures for solving problems in the various disciplines. Of course, an in-depth study must be made of a selected language (or languages) appropriate for the computer available to the particular school system.

General Objectives

The following are broadly stated objectives which identify knowledge, skills, concepts, and attitudes expected as general learning outcomes upon successful completion of this course.

1. The student develops an acute awareness of the impact of computers on our society.
2. The student learns to appreciate the influence computers have had on the advancement of technology.
3. The student gains a good understanding of the development of computers.
4. The student learns to appreciate the versatility of the computer.
5. The student gains knowledge that computers are widely used as a problem solving tool.
6. The student develops new techniques of problem solving and reinforces and extends previously learned techniques.

7. The student writes, debugs, and modifies computer programs.
8. The student gains a better understanding and mastery of mathematical concepts.
9. The student designs algorithms and constructs flowcharts.
10. The student uses the computer as a problem-solving tool.
11. The student communicates mathematical ideas.
12. The student explores and researches problems of interest to the individual.
13. The student uses the computer to simulate experiments and play games.
14. The student applies mathematical principles to solve problems in other disciplines.

COMPUTER PROGRAMMING

PROGRAM OUTLINE

I. Introduction to Computers and Programming

- A. Brief history of computers
 - 1. Counting aids
 - 2. Early machines
 - 3. Calculators
 - 4. Computers
- B. Types of computers
 - 1. Analog
 - 2. Digital
 - 3. Examples of analog and digital
- C. Major components of a computer
 - 1. Input
 - 2. Output
 - 3. Storage
 - 4. Processor
 - 5. Control
- D. Support equipment
 - 1. Keypunch
 - 2. Collator
 - 3. Terminal

II. Communicating with the System

- A. Languages for communication
 - 1. Machine language
 - 2. Symbolic language
 - 3. Overview of Basic, Fortran, etc.
- B. Accessing the system
 - 1. Direct access
 - 2. Indirect access
 - 3. Time sharing
- C. Using the system
 - 1. Running previously prepared programs
 - 2. Running student's programs
 - 3. Saving a program
 - 4. Deleting a program
- D. System commands and responses
 - 1. System commands
 - 2. System messages
 - 3. System requests for information
 - 4. User responses

III. Selected Language Development

- A. Elements of the language
 - 1. Integer constants

2. Real constants
 3. Variables
 4. Operations
 5. Library functions
 6. Order of operations
 7. Form of statements
 - B. Elementary statements
 1. Input statements
 2. Computational statements
 3. Output statements
 4. Control statements
 5. Remark statements
 6. Unconditional statements
 7. Conditional statements
 - C. Looping
 1. Features of a loop
 2. Nested loops
 3. Examples of loops
- IV. Communicating with the Computer
- A. Flowcharts
 1. Definition and symbolism
 2. Examples
 3. Purposes of a flowchart
 4. Guidelines for preparing flowcharts
 5. Preparation of flowcharts
 - B. Algorithms
 1. Definition
 2. Examples
 3. Uses of algorithms
 4. Construction of algorithms
 - C. Writing programs
 1. State problem
 2. Preparation of flowchart
 3. Construction of algorithms
 4. Print format
 5. Print functions
 6. Types of fields
 7. Arrays
 8. Dimension
 9. Subscripts
 10. Subroutines
 11. Library functions
 - D. Executing programs
 1. Execution commands
 2. Analyzing output
 3. Evaluating programs
 - E. Debugging
 1. Types of errors
 2. Error messages
 3. Correcting errors

4. Examples of debugging
5. General hints from manual

V. Designing and Executing Programs for Selected Mathematics Problems

- A. Fundamental mathematics
 1. Divisibility
 2. Rounding off
 3. GCD & LCM
 4. Primes
 5. Modular arithmetic
- B. Algebra
 1. Systems of equations
 2. Radicals and exponents
 3. Evaluating polynomial functions
 4. Logarithms and computation
 5. Matrix applications
- C. Geometry
 1. Pythagorean triples
 2. Coordinate geometry
 3. Area and volume
- D. Trigonometry
 1. Solving triangles
 2. Area of triangles
 3. Graphs of trigonometric functions
- E. Probability
 1. Random numbers
 2. Combinations
 3. Permutations
- F. Statistics
 1. Mean
 2. Median
 3. Mode
 4. Standard deviation

VI. Designing and Executing Programs for Selected Problems in Science, Business, and Other Fields

- A. Science
 1. Physics
 2. Chemistry
 3. Biology
- B. Business
 1. Accounting
 2. Economics

VII. Special Projects

- A. Selection of project
- B. Requirements of the project
- C. Simulations
- D. Games

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